https://doi.org/ 10.48047/AFJBS.6.5.2024. 9101-9114

African Journal of Biological Sciences

Influence of organic amendments along with biofertilizers on yield and yieldattributes of wheat(*triticum aestivum.L.*)with mustard(*brassica juncea*)intercropping system

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Article History
Volume 6, Issue 5, 2024
Received: 15 May 2024
Accepted: 02 Jun 2024
doi: *10.48047/AFJBS.6.5.2024. 9101-9114*

Abstract

Wheat is a grass that is extensively farmed for its seed, a cereal grain that is a global staple food.Gluten's utility in the food business is driving up global demand for wheat.Wheat is a rich source of carbohydrates. Globally, it is the primary source of vegetable proteins in human meals, with a protein level of approximately 13%, which is very high in comparison to other major cereals but rather low in protein quality (supplying key amino acids).The research was conducted with aim to check out the suitable row proportion while wheat intercropped with mustard under different organic manures and biofertilizers. The field experiment was conducted at the farm of Lovely Professional University, Phagwara on wheat(Triticum aestivum.L) intercropped with mustard(Brassica junecea.L) during rabi season in year 2020-2021. Split plot block design were used with three row proportions of wheat + mustard intercropping of (3:1) (2:2) and sole wheat (main crop), and four treatments of different manures and biofertilizers and three replications. Based on the complete analysis of experimental results it is concluded,that different treatments effects the wheat + mustard intercropping, there was a significant increase in yield attributes and yield, among the geometries G_1 (sole wheat) shown good results of biological, economical, straw yield and harvest index in M_4 (vermicompost 5t/ha + + Azospirillum + PSB) in all geometries.there is no significant increase in harvest index in all geometries and treatments,but highest net returnswas observed in Geometry 2 (2:2 wheat + mustard) of treatment no:3 (M_3 poultrymanure 5t/ha + PSB + Azospirillum).Hence research outcomes (2:2) wheat + mustard intercropping by applying of (M_3) poultry manure along with biofertilizers is beneficial to farmers.

1.Introduction

The word Intercropping means cultivation of two or more crops on the same field at the same time together in a beneficial manner by making use of all the available resources. The crops selected for intercropping must be of different species and the crop species are economically different. As the crop species selected are different from each other, there may interspecific competition among them. Intercropping technique also provide good management of spaces in the land and full usage of land. It also increases the soil fertility. Intercropping is beneficial than sole crops as the sole crops do not make use of all the available resources. In

Intercropping system , the selected crop species are sown parallely in order to increase the crop production.There will be upsurge in crop production with the space utilisation and time management.(Ahlawat and Sharma,2002).Wheat (Triticum aestivum L.) is the most widely cultivated food grain crop among cereals, providing more than half of the calories to those who rely on it. It is the primary food crop in most parts of the world and will continue to be a major player in the Indian food sector. It is mostly consumed in the form of "Chapati" bread, while "Straw" is used to feed cattle. Mustard (Brassica juncea) is an annual oilseed crop from the cruciferous family. India is a major producer of rapeseed and mustard in the world. The area of rapeseed and mustard in India is 5.80 million hectares, with a production of 6.30 MT and a productivity of 10.89 q/ha. (Anon., 2015-16).Wheat (Triticum spp.) is world's most broadly developed food crops. It is primarily a rabi season crop in India. It has pretend a crucial part in balancing out the food grain creation in the country in the course of recent years. In India , it is the second significant staple oat food.Wheat is being developed since pre-noteworthy occasions. From all conceivable record, it appears to be that its focal point of source is South Western Asia. It is accepted that Aryans brought wheat grains to India. As indicated by De Candolle, the wheat was started in the Eupharates and Tigris and spread from that point to China, Egypt and different pieces of the world. Mustard (Brassica juncea) is an annual oilseed crop from the cruciferous family. India is a major producer of rapeseed and mustard in the world. The area of rapeseed and mustard in India is 5.80 million hectares, with a production of 6.30 MT and a productivity of 10.89 q./ha (Anon., 2015-16). The seeds and oil are used as a condiment in pickles and to flavour curries and vegetables. The oil is used for human consumption in northern India for cooking and frying. Intercropping is a form of cropping system in which two or more crops are grown on the same piece of land with a certain row arrangement. It is a technique for increasing crop productivity and managing risk through the optimal use of resources. Important cereal and pulse crops can be used as intercrops with citronella to determine their workability. These crop combinations can be demonstrated to seek risk coverage under the current changing climate situation. (Ansari et al., 2015).Singh (2011) performed a primary research and announced that growing of wheat organically is beneficial and decreased yield may be a challenging situation for our country in case of food security. Information regarding this was gathered from Patiala and Faridkot districts of Punjab. Wheat crop is only examined . Specific study is applied only for student test and Cobb-douglas function. The results stated that net return is maximum in case of organic farming instead it gains only minimum production but it is paid back by its higher prices.The use of biofertilizers helps in the improvement of yield in crops by 20-30 % .They also helps in availablity of nitrogen by 25 percent. Biofertilizers also works as natural growth promoters as it helps in growth of the plants. It also bring back the fertility and microbes present in the soil are also activated.Plants become resistant for both drought and soil borne diseases after inoculating them with biofertilizers (Anonymous,2009b).

2.Materials and methods

2.1 Experimental site location:

Experiment was conducted at the farm of lovely professionaluniversity Phagwara district kapurthala late forth november in year 2020-2021. The farm is situated at 3122’31.81’’ North latitude and 7523’03.02‖ East longitude with 252m average elevation above mean sea level. It is at 350 km distance from capital of India (Delhi) in Punjab fall under sub tropical region in central plane of state agro climatic zone.

2.2 Sources of nutrients used in the experiment

1) manure application:

(a) Farm yard manure (b) Poultry manure (c) Vermicompost

2)Bio fertilizer:

(a) azospirillum (b) phosphate solubulizing bacteria(psb)

2.3 History of cropping site

At the experiment conducted at organic farming site, farm of lovely professionaluniversity, Phagwara district kapurthala, organic cultivation is followed from many previous years at organic farming site near tube well no 5 organic farm of lpu.ladys finger and tomato crop is planted in organic cultivation as previous crop before planting the experiment.

2.4 Experimental Design and Layout

The experiment was laid out in split-plot design comprising three row proportions of wheat + mustard intercropping i.e. 3:1, 2:2, and sole wheat in main-plots and four different treatments of manures along with two biofertilizers of farmyard manure,poultry manure,vermicompost,azospirillum,phosphate solubulizing bacteria(psb) in sub-plots. Thus, total twelve {(3 main-plots x 4 sub-plots)} treatment combinations were formed. The treatments were allocated to each plot randomly using random number (Fisher and Yates, 1963) and replicated three times.

2.5 Crops and Variety

The salient characteristics of the crop variety used in the experiment are given below:

2.5.1 Wheat (PBW-343)

Plant height is 100-110 cm. Earheads are white in colour. Suited for cultivation in the northern plains of Punjab, Western U. P. , Uttarakhand and irrigated plains of Haryana. Crop is ready for harvest in approx 130-135 days from timely sowing. Under optimum conditions, estimated yield is 55-60 quintals per hectare.

2.5.2 Mustard (Vardan)

This variety was released by Chandra Shekar Azad University of Agriculture and Technology, Kanpur (U.P.) in 1985 for irrigated condition. The yield potential of Vardan is 20-25 q ha-1 and oil content of 40.2%. It is suitable for intercropping with wheat and for cultivation in irrigated areas of Uttar Pradesh and Madhya Pradesh. It has resistance amongst Altenaria blight and white rust. Its maturity period ranges between 110-115 days

3.Result and Discussion

3.1 Wheat

3.1.1 Effect of row proportions, and different types of manures on yield attributing characters of wheat in wheat + mustard intercropping.

The data on yield attributes of wheat both as in intercropping and in sole stand are presented in Table 3.1.1 and described here under treatment wise and row proportions.

3.1.1.1 Grain spike-1

The data on number of grain spike^{-1} recorded from this experiment found that treatment number (M_3)(puultry manure + Azospirillum + psb),(M_2)(fym + azospirillum + psb) and (M_4) (vermicompost + azospirillum + psb) gives significant result in which treatment number (M_3) shows 15% , treatment number (M_2) shows 15%,and (M_4) shows 14% higher number of grain/spike^{-1} oveer the control treatment. Treatment number (M_1) shows least number of grain/spike^{-1} and all other treatments are statistically similar to each other. Among geometry treatments of sole,2:2, 3:1 wheat + mustard intercropping G_1M_3,G_1M_4,G_1M_2 have shown more number of grain/spike recorded, When compared with the control plots in the all geometrys. Data recorded according to the geometry wise(crop ratios)in (G_1) sole recorded more number of grain /spike than in intercropping wheat with mustard (G_2)(2:2)wheat + mustard, recoreded more number of grain/spike than (G_3)(3:1) wheat + mustard.hence both (G_1) & (G_2) recorded more number of grain/spike over the (G_3)(3:1) wheat + mustard , thus the grain/spike have 54.5 ,54.533,and 53.358, thus all geometries(G_1,G_2,&G_3) statistically similar to each other.

3.1.1.2 Spike length (cm)

The data on spike length observed from this experiment found that treatment number (M_4) (vermicompost + azospirillum + psb) , (M_2)(fym + azospirillum + psb) and (M_3)(puultry manure + Azospirillum + psb) are superior from among the control treatment. Treatment number (M_4) has 11% , (M_2) has 6% and (M_3) has 2% superior in comparison to control treatment but both (M_3&M_4) and (M_1&M_2) treatment are statistically similar to each other. Observed data of spike length given in table number 4.1.3. Among geometry treatments of sole,2:2, 3:1 wheat + mustard intercropping G_1M_3,G_1M_4,G_1M_2 and G_2M_2 have shown highest spike length, When compared with the control plots in the all geometrys. Data summarized in Table 4.1.3, revealed profound variations on spike length due to different row proportions of wheat + mustard intercropping, (G_1) sole produced significant increase in spike length than in intercropping wheat with mustard (G_2)(2:2)and (G_3)(3:1),hence maximum spike length was recorded in wheat pure stand but it reduced due to intercropping with mustard. Sole wheat showed its distinct superiority over the intercropping by recording 10.453 longer spike length.and have (G_2)&(G_3)records 9.533&9.29.

3.1.1.3 Spikelet spike-1

Wheat grown in association with mustard in all the proportions, markedly affected the spikelets production spike-1 of wheat. However, the maximum spikelets spike-1 was obtained with (G_1) sole which proved significantly superior over (G_3)3:1, and ((G_2)2:2 row proportions. Among geometry treatments of sole,2:2, 3:1 wheat + mustard intercropping G_1M_3,G_1M_4,G_1M_2 and G_3M_4 have recorded highes number of spikelet spike^{-1}, When compared with the control plots in the all geometrys.The data on spikelet spike obseved from this experiment found that treatment number (M_4) (vermicompost + azospirillum + psb) and (M_3)(puultry manure + Azospirillum + psb) was applied to wheat correspondingly increased

spikelets spike-1 of wheat superior than (M_2)&(M_1).all treatments are superior in comparision to the control treatmemt(M_1).spikelet spike have 17.811,18.233&18.378.Wheat in pure stand recorded significantly higher number of spikelet spike-1 than intercropping mean.

3.1.1.4 1,000- grain weight (Test weight)

A close examination of the data presented in Table 3.1.1., revealed that profound variations on 1,000-grain weight of wheat in gram due to different row proportions of wheat + mustard intercropping. Among(G_1) Sole wheat, produced significant increase in 1,000-grain weight,over the two crop ratios of intercropping(G_2)(wheat + mustard) & (G_3)(wheat + mustard).and Minimum 1,000-grain weight was observed with (3:1) row proportion which was significantly higher than that of (2:2) row proportion. Thus, the application of (M_2)(fym manure + azospirillum + psb) and (M_4)(vermicompost + azospirillum + Psb) observed highest 1000 seed weight which was statically at par with and (M_3)(poultry + azospirillum + Psb). However, the lowest 1000 seed weight was observed with control from all the treatments.Nevertheless, sole stand of wheat recorded significantly higher 1,000- grainweight remained at par with mean intercrop.

Table 3.1.1. Effect of row proportions, and different types of manures on yield attributing characters of wheat inwheat + mustard intercropping.

GEOMETRIES	Spike length(cm)	Spike weight(g)	Number of spikelets per spike^{-1}	Number of grains spike^{-1}	1,000 grain weight
Row proportions					
Sole wheat	10.453	3.65	18.142	54.5	42.025
2:2 wheat + mustard	9.533	3.62	17.8	54.533	40.725
3:1 wheat + mustard	9.29	3.837	17.675	53.358	41.24
SE(m±)	0.149	0.047	0.161	0.374	0.461
CD (P=0.05)	0.6	NS	NS	NS	NS
Treatments					
Control	9.417	3.479	17.067	48.311	39.6
Fym + azospirillu+psb	9.884	3.724	17.811	56.378	42.056
poultry + azospirillum +psb	9.561	3.831	18.233	56.6	41.444
vermicompost+azospirillum+psb	10.173	3.774	18.378	55.233	42.22
SE(m±)	0.173	0.095	0.228	0.71	0.371
CD (P=0.05)	0.517	NS	0.682	2.125	1.111

3.1.2 Effect of row proportions, and different types of manures on yield of wheat in wheat + mustard intercropping

3.1.2.1 Biological yield (kg ha-1)

Data presented in Table 3.1.2, revealed significant variation on biological yield of wheat due to various row proportions.The lowest bilogical yield was obtained with (2:2)(wheat + mustard) row proportion of wheat and mustard intercropping. bilogical yield of wheat markedly increased with (G_1)sole wheat row proportion and minimum biological yield was observed with (3:1)(wheat + mustard) row proportion, and proved significantly superior to (2:2)(wheat + mustard). Perusal of the data clearly showed that pure stand of wheat produced significantly higher biological yield in comparison to mean value of intercropping. Among geometry treatments of sole,2:2, 3:1 wheat + mustard intercropping G_1M_3,G_1M_4,G_1M_2 have shown highest biological yield, When compared with the control plots in the all geometrys. Among the different manures and biofertilizer levels, the biological yield were recorded the highest with the application of (M_4)(poultry + azospirillum + psb) and (m3)(poultry manure + azospirillum + Psb) which was at par with (M_3) (fym + azospirillum + psb). Consistently, the lowest biological yield was recorded with control.however all treatments shows significant increase on biological yield over the control.

3.1.2.2 Grain yield (kg ha-1)

A critical examination of the data on wheat grain yield was presented in Table 3.1.2. while comparing to the treatments,the grain yield higher in (M_4)(Vermicompost + azospirillum + Psb) than that in the (M_3)(poultry manure + azospirillum + psb) & (M_2)(fym + azospirillum + psb).hence all the treatments recorded significatly higher grain yield over the control treatment. Different row proportions exhibited perceptible variation on the wheat grain yield in Intercropping of wheat + mustard in (G_1) (sole) row proportion significantly recorded maximum grain yield over the both row proportion of (3:1)(wheat + mustard) & (2:2)(wheat + mustard)respectievely,however the (3:1)(wheat + mustard) recorded significantly higher than (2:2)(wheat + mustard),and lower than G_1(sole). However, the lowest grain yield was observed in (2:2)(wheat + mustard) row proportion. Hence, wheat in pure stand recorded significantly higher number of grain yield than intercropping mean.

3.1.2.3 Straw yield (kg ha-1)

Data presented in Table 3.1.2, revealed significant variation on straw yield of wheat due to various row proportions.The lowest straw yield was obtained with (2:2)(wheat + mustard) row proportion of wheat and mustard intercropping. Straw yield of wheat markedly increased with (G_1)sole wheat row proportion and minimum straw yield was observed with 3:1 row proportion, and proved significantly superior to (2:2)(wheat + mustard). Perusal of the data clearly showed that pure stand of wheat produced significantly higher straw yield in comparison to mean value of intercropping. Among the different manures and biofertilizer levels, the straw yield were recorded the highest with the application of (M_4)(poultry + azospirillum + psb) and (M_3)(poultry manure + azospirillum + Psb) which was at par with

(M_2) (fym + azospirillum + psb). Consistently, the lowest straw yield was recorded with control.however all treatments shows significant increase on straw yield over the control.

3.1.2.4 Harvest Index (%)

Data on harvest index are summarized in Table 3.1.2. A perusal of the data indicated slightly similar values in harvest index of wheat while compared to the different row proportions of all geometries. Data further revealed that differences in harvest index due to various treatments were statistically non-significant.

Table 3.1.2 Effect of row proportions, and different types of manures on yieldofwheat in wheat + mustard intercropping.

GEOMETRIES	Biological yield	Grain yield	Straw yield	Harvest index
Row proportions				
Sole wheat	126.25	53.45	72.4	42.25
2:2 wheat + mustard	73.167	30.858	42.308	42.208
3:1 wheat + mustard	88.583	37.842	50.742	42.8
SE(m±)	1.426	0.749	0.204	0.942
CD (P=0.05)	5.751	3.019	4.853	NS
Treatments				
Control	77.556	32.922	44.1	42.6
Fym + azospirillum+psb	98	41.211	56.789	42.078
poultry + azospirillum +psb	101.444	43.211	58.233	42.567
vermicompost+azospirillum+psb	107	45.522	61.478	42.433
SE(m±)	1.091	0.728	0.257	0.997
CD (P=0.05)	3.268	2.18	3.763	NS

3.1.3 Land equivalent ratio(LER) of wheat as influenced by row proportions, and different manure appilcations in wheat + mustard intercropping.

The LER of wheat (LERwheat) as influenced by varying treatments (Table 3.1.3) were found less than one indicating that the main crop wheat in wheat + mustard intercropping system could not out yield itself over the sole crop of wheat on unit area basis. While comparing the different intercrop combinations, Accordingly, maximum wheat LER was observed under 3:1 row proportion, which proved significantly superior to (2:2) (wheat + Mustard) row proportion.according to the treatments while recorded from lower to higher markedly enhanced the wheat LER The maximum partial LER of wheat was recorded with in the geometries (G_1M_1 control), which was at par G_3M_4 (vermicompost +azospirillum + psb) were recoreded highest among all treatments in the geometries. However, the lowest was recorded in G_2M_4,G_2M_2 and G_2M_3,Hence G_2M_2 and G_2M_3 statistically similar to each other.

Table 3.1.3 Land equivalent ratio of wheat by influence of different row proportions

GEOMETRIES	Land equivalent ratio (LER)
Row proportions	
2:2 wheat + mustard	0.591
3:1 wheat + mustard	0.792
SE(m±)	0.01
CD (P=0.05)	0.067
Treatments	
Control	0.758
Fym + azospirillum+psb	0.586
poultry + azospirillum +psb	0.616
vermicompost+azospirillum+psb	0.648
SE(m±)	0.02
CD (P=0.05)	0.061

3.2 Mustard

3.2.1 Effect of row proportions, and different types of manures on yield attributing characters of mustard in wheat + mustard intercropping.

The data on maturity attributes of mustard as intercrop showed distinct impact on their relative performance due to different types of manures.

3.2.1.1 Number of siliquae plant-1

Scanning of the data revealed significant variation on number of siliquae plant-1 of mustard due to different row proportion of wheat + mustard intercropping. Maximum number of siliquae plant-1 was noticed with 2:2 row proportion followed by 3:1 row proportion. However,both the geometries the number of siliqua plant-^{1} have recorded 259 & 256. According to the different manures and biofertilizer application to mustard correspondingly enhanced the production of siliquae plant-1 . Thus the application of (M_3) (poultry manure + azospirillum + psb) significantly higher number of siliquae plant-1 which was statically at par with (m2)(fym + azospirillum + psb) and (M_4)(vermicompost + azospirillum + Psb). . However, the lower number of siliquae plant-1 was observed in control. Perusal of the data clearly showed that all treatments on mustard produced significantly higher number of siliquae plant-1 followed by control.

3.2.1.2 Siliqua length (cm)

Data revealed profound variations on siliqua length due to different row proportions of wheat + mustard intercropping. Among two rows of mustard in wheat+ mustard intercropping, (2:2) increase in row proportion from (3:1) produced significant increase in siliqua length. However,both the geometries the siliqua length(cm)have recorded 5.78 & 5.59. Among the different manures and biofertilizer levels, siliqua length were recorded the highest with the application of (M_2)(fym + azospirillum + psb) and (M_4)(vermicompost + azospirillum + Psb) which was at par with (M_3) (poultry manure + azospirillum + psb. Consistently, the lowest siliqua length was recorded with control.however all treatments shows significant increase on siliqua length over the control.

3.2.1.3 Number of seed siliqua^{-1}

Scanning of the data revealed significant variation on number of seed siliqua-1 of mustard due to different row proportions of wheat + mustard intercropping. Maximum number of seed siliqua-1 was noticed in 3:1 row proportion followed by 2:2 row proportions. However, Among the different manures and biofertilizer application to correspondingly enhance the production of number of seed siliqua-1. Thus, the application of (M_2)(poultry + azospirillum + psb) and (M_4)(vermicompost + azospirillum + Psb) observed highest number of seed siliqua-1 which was statically at par with and (M_2)(fym + azospirillum + Psb). However, the lowest number of seed siliqua-1 was observed with control from all the treatments

3.2.1.4 1000-seed weight (g)

An inspection of the data on 1000-seed weight indicated that the both row proportions on mustard in wheat + mustard intercropping a failed to affect the 1000-seed weight to the level of significance. However, among the different manures and biofertilizer application to correspondingly enhance the weight of 1000 seed weight(g). Thus, the application of (M_3)(poultry manure + azospirillum + psb) and (M_4)(vermicompost + azospirillum + Psb) observed highest 1000 seed weight which was statically at par with and (M_2)(fym + azospirillum + Psb). However, the lowest 1000 seed weight was observed with control from all the treatments.

Table 3.2.1 Effect of row proportions, and different types of manures on yield attributing characters of mustard in wheat + mustard intercropping.

GEOMETRIES	Number of siliquae/plant	Siliqua length (cm)	Number of seed/siliquae	1,000 weight
Row proportions				
sole wheat	0	0	0	0
2:2 wheat + mustard	259.975	5.783	17.5	3.628
3:1 wheat + mustard	256.967	5.592	17.917	3.668
SE(m±)	0.455	0.088	0.199	0.022
CD (P=0.05)	2.981	NS	NS	NS
Treatments				
Control	242.3	5.433	16.4	3.397
Fym + azospirillu+psb	258.05	5.833	17.55	3.532
poultry + azospirillum +psb	269.667	5.683	18.567	3.917
vermicompost+azospirillum+psb	263.867	5.8	18.317	3.745
SE(m±)	0.899	0.137	0.663	0.087
CD (P=0.05)	2.802	NS	NS	0.271

3.2.2 Effect of row proportions, and different types of manures on yield, harvest index and seed oil content of mustard in wheat + mustard intercropping.

3.2.2.1 Seed yield (q ha-1)

A critical examination of the data on mustard seed yield was presented in Table 3.2.2. According to the row proportion the highest seed yield was noticed with (2:2) wheat + mustard which was significantly higher than (3:1)wheat + mustard row proportion.the seed yield was recorded 14.3 & 8.34.The Data on production of seed yield recorded while compare to the treatments (M_4) (vermicompost manure + azospirillum + psb), (M_3)(poultry + azospirillum + psb) and (M_2)(fym + azospirillum + Psb) treatments,hence all treatments recorded significantly more seed yield than (M_1)control treatment. Treatments while recored have 11.3, 11.8, and 12.6 more seed yield over the (M_1)control treatment.

3.2.2.2 Straw yield (q ha-1)

A critical examination of the data on mustard straw yield was presented in Table 3.2.2. According to the row proportion the highest straw yield was noticed with (2:2) wheat + mustard which was significantly higher than (3:1)wheat + mustard row proportion.the straw yield was recorded 12.03 & 7.053.The Data on production of straw yield recorded while compare to the treatments (M_4) (vermicompost manure + azospirillum + psb), (M_3)(poultry + azospirillum + psb) and (M_2)(fym + azospirillum + Psb) treatments hence all treatments recorded significantly more seed yield than control treatment. Treatments while recored have 9.65, 10.3, and 9.86 more straw yield over the control treatment.

3.2.2.3 Stover yield (q ha-1)

A critical examination of the data on mustard stover yield was presented in Table 3.2.2. According to the row proportion the highest stover yield was noticed with (2:2) wheat + mustard which was significantly higher than (3:1)wheat + mustard row proportion.The Data on production of stover yield recorded while compare to the treatments (M_4) (vermicompost manure + azospirillum + psb),& (M_3)(poultry + azospirillum + psb) significantly increased more stover yield than the (M_2)(fym + azospirillum + Psb) & (M_1)(control) treatments hence both (M_4) (vermicompost manure + azospirillum + psb),& (M_3)(poultry + azospirillum + psb) statistically similar to each other and (m2)(fym + azospirillum + Psb) & (M1)(control) treatments statistically similar to each other . Treatments while recorded have 32.92, 32.90,35.7 and 35.5.

3.2.2.4 Biological yield (q ha-1)

A critical examination of the data on mustard biological yield was presented in Table 3.2.2. According to the row proportion the highest biological yield was noticed with (2:2) wheat + mustard which was significantly higher than (3:1)wheat + mustard row proportion.the biological yield was recorded 72 & 38.25.The Data on production of bological yield recorded while compare to the treatments (M_4) (vermicompost manure + azospirillum + psb), (M_3)(poultry + azospirillum + psb) and (M_2)(fym + azospirillum + Psb) treatments recorded significantly more biological yield than over the control treatment. Treatments while recored have 57.6, 57, and 57 more biological yield than the(M1) control treatment.

3.2.2.5 Harvest index (%)

The data on mustard harvest index was presented in Table 3.2.2. According to the row proportion the highest harvest index was noticed with (3:1) wheat + mustard which was significatly higher than (2:2)wheat + mustard row proportion.the harvest index was recorded 19.59 & 21.94.The Data on harvest index recorded while compare to the treatments (M_4) (vermicompost manure + azospirillum + psb), (M_3)(poultry + azospirillum + psb) treatments recorded significantly more harvest index than over the (M_2)(fym + azospirillum + Psb) and (M_1) control treatment. Treatments while recorded have 19.93,19.72,21.39 & 22. Hence (M_4) (vermicompost manure + azospirillum + psb), & (m3)(poultry + azospirillum + psb) statistically similarly to each other and the (M_2)(fym + azospirillum + Psb) and (M_1) control treatment are also statistically similar to each other.

3.2.2.6. Oil content (%) in seed

Data on seed oil content of mustard pertaining to different treatments are presented in Table 3.2.2. A close examination of the data showed progressive increase in oil content of seed due to treatments (M_4) (vermicompost manure + azospirillum + psb), (M_2)(fym + azospirillum + psb)both statistically similar to each other and increases significantly more seed oil content over the (M_3)(poultry manure + azospirillum + Psb) and (M_1) control.hence all all the treatments statistically non significant. According to the mustard proportion in varying row proportion of wheat + mustard intercropping. However, there is no significance difference was noted in both row combinations(3:1) & (2:2). Thus both the geometries statisitically non significant.

Table 3.2.2 Effect of row proportions, and different types of manures on yield, harvest index and seed oil contentof mustard in wheat + mustard intercropping.

GEOMETRIES	Biological yield	Seed yield	Straw yield	Stover yield	Harvest index	Oil content
Row proportions						
Sole wheat	0	0	0	0	0	0
2:2 wheat + mustard	73	14.317	12.034	43.741	19.592	38.398
3:1 wheat + mustard	38.25	8.342	7.053	24.807	21.945	38.977
SE(m±)	0.445	0.195	0.778	2.436	0.152	0.048
CD (P=0.05)	2.914	1.276	4.769	15.371	0.999	0.316
Treatments						
Control	50.833	9.5	8.285	32.92	19.937	37.498
Fym + azospirillu+psb	57.667	11.383	9.658	32.902	19.723	37.498
poultry + azospirillum +psb	57	11.833	10.367	35.773	21.395	37.498
vermicompost+azospirillum+psb	57	12.6	9.865	35.5	22.018	37.498
SE(m±)	1.248	0.141	0.771	1.933	0.477	0.502
CD (P=0.05)	3.889	0.439	NS	NS	1.485	1.565

Conclusion

Application of manures and biofertilizers in wheat + mustard intercropping, there was a significant increase in spike length, spike weight, number spikelets spike^{-1}, number of grains spike^{-1},number of siliqua/ seed,stover yield,biological yield, yield, harvest index and 1000 seed weight,there is no significant increase in all geometries. By applying of (M4 vermicompost+azospirillum +psb)there was significant increase compared to control. There was further significant increase when applied (M3 poultry manure+ azospirillim + psb) was increased. There was no significant increase in both the geometries and all treatments of harvest index of both the crops.there was significant increase yield in (M4 vermicompost + azospirillum + psb) in all geometries of wheat + mustard intercropping of both crops.but highest net returns was increased was observed in Geometry 2 (2:2 wheat + mustard) of treatment no:3 (M3 poultrymanure 5t/ha + PSB + Azospirillum).Hence research outcomes

(2:2) wheat + mustard intercropping by applying of (M3) poultry manure along with biofertilizers is beneficial to farmers.

References

Anonymous. United state department of agriculture, 2016-17.

Ansari MH, Verma BK, Ansari MA, Mishra D, Srivastava AK, Khan N et al. Impact of cropping pattern on growth, yield attributes and system productivity of citronella (Citronella winterianus) pulses intercropping system in Central India. *The Indian Journal of Agricultural Sciences*. 2015; **85(**3).

Singh Inder Pal, Grover D.K.(2011), "Economic Viability of Organic Farming: An Empirical Experience of Wheat Cultivation In Punjab", *Agriculture Economics Research Review*, Vol.24, pp 275-281

Ahlawat, I.P.S. and Sharma, R.P. (2002). Agronomic Terminology. IARI, New Delhi. pp. 1322.

Anonymous. (2009b). Bio-fertilizer and sustainable forming. In: Bio-Fertilizer for Sustainable Agriculture (Jain, V. K eds.). p. 149-179.

Burra Shyamsunder* , Dr. Sandeep Menon, Dr. Ujagar Singh Walia, Thulisekari Prasanna, Guntimadugu Sanhthosh Kumar Raju, Prudhvi Nawabpet. (2024)."Effect of intercropping wheat (triticum aestivum.L.) with mustard (brassica juncea) on yield and economics under organic system of cultivation".*Int. J. Environ. Agric. Biotech*.**9** (2) 218-223